AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



MARK SCHEME

4.5.7 MOMENTUM (PACK 1)

SCORE	PERCENTAGE
/70	%

STEMUP

These questions belong to AQA, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by AQA. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with AQA and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. AQA has not endorsed, approved or been involved in the production of it. AQA and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

AQA publishes its past papers, mark schemes and examiner reports. Always check the current specification at aqa.org.uk before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Q1.

(a) increases

1

(b) the band returns to its original shape

allow band gets shorter

1

because there is an elastic force

allow because the stretching force has been removed

*if no other mark has been scored, allow for **1** mark the elastic potential energy decreases*

1

(c) any **two** from:

- initially the band does not stretch when a force is applied

  allow a certain force is needed before the band extends

- (when extending) as force increases the extension increases

- the relationship is non-linear

  allow the increase is not proportional

  *do **not** accept directly proportional*

2

(d) straight diagonal line from bottom left to top right

allow the line to curve upwards beyond the elastic limit

1

straight line through the origin

1

(e) force = spring constant × extension

allow $F = k\ e$

1

(f) 7.5 cm = 0.075 m

1

$F = 1\ 600 \times 0.075$

this mark may be awarded if e is incorrectly / not converted

1

$F = 120$ (N)

allow an answer that is consistent with their value of e

1

*an answer of 120 (N) scores **3** marks*
*an answer of 12 000 (N) scores **2** marks*

STEMUP.CO.UK

[11]

Q2.

(a) momentum = mass × velocity

allow p = mv

1

(b) 200 = m × 3.2

1

$$m = \frac{200}{3.2}$$

1

m = 63 (kg)

allow 62.5 (kg)

1

*an answer of 63 (kg) scores **3** marks*

(c) (total) momentum before (collision) = (total) momentum after (collision)

1

either

momentum of skater A decreases and momentum of skater B increases

allow (total) momentum is shared between skater A and skater B

1

velocity of skater A decreases and velocity of Skater B increases

1

or

momentum of skater A decreases and so velocity of skater A decreases (1)

momentum of skater B increases and so velocity of skater B increases (1)

[7]

Q3.

(a) air resistance

allow drag

ignore wind resistance

1

(b) B−C

1

(c) (velocity =) 12.2 (m/s)

1

(momentum =) 94.8 × 12.2

1

(momentum =) 1160 (kg m/s)

allow an answer that rounds to 1160 (kg m/s)

*an answer of 1147 / 1150 scores **2** marks*

STEMUP.CO.UK

1

*an answer of 1160 (kg m/s) scores **3** marks*

(d) tangent drawn at 12 s

1

correct readings of Δv and Δt from tangent

1

$$(\text{acceleration}) = \frac{\text{their value of } \Delta v}{\text{their value of } \Delta t}$$

1

−2.4 (m/s^2)

allow value in range −2.2 to −2.6 (m/s^2)

allow a correctly calculated answer from $-\frac{\textit{their value of } \Delta v}{\textit{their value of } \Delta t}$

1

m/s^2

allow m/s/s

1

(e) straight line (with gradient of 1.6) from origin to 6 s, 9.6 m/s

*allow **1** mark for a straight line below A−B with a positive gradient from origin to 6 s*

2

(f) (calculation of distance travelled by first athlete)

(2.2 × 12.2) = 26.84 (m)

1

(0.5 × 3.8 × 12.2) = 23.18 (m)

1

*an answer of 50.02 (m) scores **2** marks*

(calculation of distance travelled by second athlete)

(0.5 × 9.6 × 6 =) 28.8 (m)

*allow ecf from part **(e)***

allow ($9.6^2 - 0 = 2 \times 1.6 \times s$ =) 28.8 (m)

1

(calculate difference) = 21.22 (m)

allow their distance for athlete 1 minus their distance for athlete 2

1

*an answer of 21.22 (m) scores **4** marks*

[16]

Q4.

(a) inertia

1

STEMUP.CO.UK

(b) 17 cm/s = 0.17m/s

1

$P = mv = 0.14 \times 0.17$

1

= 0.024 (kg m/s)

*an answer of 0.024 (kg m/s) scores **3** marks*

1

(c) the total momentum before the collision is zero

1

and momentum is conserved

1

so the total momentum after the collision is zero

1

so the speed after the collision is zero

1

(d) more than one car may pass through a beam at a time

allow a description of this eg cars overtaking, cars passing in opposite directions etc

1

(so) the light gate could not accurately measure the time for one car to pass

1

the length of each car would be unknown

allow cars come in different lengths.

1

(so) speed could not be calculated without the length

ignore references to the data logger

1

[12]

Q5.

(a) mass

1

velocity

1

(b) kg m / s

1

(c) momentum before = momentum after

1

and before diving in the momentum of the diver and (small) boat is zero

1

after diving the diver has forwards momentum / momentum to the right

1

therefore the (small) boat has equal backwards momentum / equal momentum to

STEMUP.CO.UK

the left

1

(d) the boat moves back more slowly

1

because there is more mass (but momentum stays the same)

1

(e) as she swims there is a drag force

1

as speed increases so does the drag force

1

she accelerates less

1

drag force = thrust force

accept resultant force = 0

1

the swimmer reaches terminal velocity

1

[14]

Q6.

(a) acceleration = change in velocity / time taken

allow a = Δv / t

1

(b) $= \frac{(3 - 5)}{6}$

1

–0.33 (m / s^2)

1

*allow 0.33 m / s^2 with no working shown for **2** marks*

(c) force = mass × acceleration

allow F = m a

1

(d) 70 × 0.33

allow ecf from 4.3

1

23.1 (N)

*allow 23.1 with no working shown for **2** marks*

1

(e) before throwing the bag the momentum of the skater and bag is zero

1

when it is thrown the bag has momentum forwards

1

because momentum before = momentum after

STEMUP.CO.UK

1

the skater has equal backwards momentum so will move backwards

1

[10]

STEMUP.CO.UK

Q1.

(a) Just over 42% gave correct descriptions such as “increases” or “gets bigger”. Some students gave responses of “stronger” which did not gain credit.

(b) Although 55% gained one mark for describing what happened to the resistance band, only 1% gained two marks for a complete explanation. Explain questions always require more than a one-mark response.

(c) Similarly, 58% gained one mark for describing the extension increasing as the force increased. References to the start of the graph at which the band did not stretch even though a force was applied, or the overall relationship being non-linear were much less common with only 5% scoring two marks.

Lower attaining students often referred to just one variable or to the shape of the graph.

(d) Only 16% scored both marks with a further 13% scoring one mark. Many copied the sketch graph from the previous page rather than sketching the graph for a spring. Others produced various curves and squiggles which indicated they were unfamiliar with the extension of a spring.

(e) 24% of the students correctly recalled this equation. Many quoted the equation for elastic potential energy having referred to the Physics Equations Sheet.

(f) Of those that gave the correct equation, most failed to convert the centimetres to metres. Only 2% gained three marks with a further 30% scoring two marks.

Q2.

(a) 82% scored this mark, with many giving the equation in the form mass = momentum ÷ velocity.

(b) 86% were able to gain 3 marks in this question and only a very small number multiplied the two numerical values.

(c) Fewer than 2% scored full marks for this question. Very few attempted to describe what happened to the velocity of the skaters, in spite of the very clear lead in the stem of the question. Whilst many realised that the velocity of the two skaters was the same after collision, they talked of velocity being ‘shared’ rather than saying what had happened to each skater.

A significant number did gain a mark for saying that the momentum before the collision was equal to that after, although many missed this mark, simply repeating the stem of the question.

Q3.

(a) Most correct answers gave air resistance, though drag was also credited. Incorrect responses included friction, gravity, wind, wind resistance, resistance, types of energy and acceleration.

(b) 86% of students were able to interpret the graph correctly.

STEMUP.CO.UK

(c) 23% of students achieved all three marks. Some students were not able to correctly apply the scale and incorrectly read the value for the velocity for the graph. The only incorrect velocity value which was credited when used in marking points two and three was 12.1 m/s. Many students incorrectly used the time of 6 s given in the question as the velocity.

(d) To access the first four marking points, students had to draw a tangent. 4% of students who had the necessary mathematical skills were able to achieve full marks. A significant number used the co-ordinates of the point on the graph, whilst others made a triangle out of the deceleration part of the graph and tried to work from the *x* and *y* readings despite there being a curve on the third side. The unit mark was scored by the majority of students. Relatively few did not attempt this question.

(e) 38% of students realised that the acceleration value given led to a velocity of 9.6 m/s after six seconds and then correctly drew the line to obtain two marks. Others who didn't use the acceleration value given drew their line to a velocity of 1.6 m/s or 12.2 m/s.

Some students drew a vertical line upwards from six seconds until it reached the other athlete's 'steady speed' section at 12.2 m/s.

(f) Those students who knew that the area under the graph represented distance were often then able to go on and achieve four marks. Others who gained some marks found it easier to calculate the area of the triangle for the distance travelled by the second athlete, rather than calculating the area of the trapezium for the first athlete. Few used the equation for the area of a trapezium, more usually splitting the trapezium into a rectangle and triangle.

For the calculation of the distance travelled by the second athlete an error carried forward was allowed from their answer to part **(e)**. Some tried to use the equation $v^2 - u^2 = 2as$ for both athletes, without appreciating that this could only be used for the second athlete.

Many tried to use $d = s \times t$ gaining an overall answer of 15.6 m. They were awarded marking point four if they had clearly indicated they had calculated the distance travelled for both athletes. Others just subtracted the two velocities after six seconds.

STEMUP.CO.UK